PATENT APPLICATION

#11/B
Andy J. McMillan 8/2/02

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Nobuaki HASHIMOTO

Application No.: 09/720,860

Filed: January 2, 2001

Group Art Unit: 2827

Examiner: L. Thai

Docket No.: 108102

For: SEMICONDUCTOR DEVICE AND METHOD OF MANUFACTURE THEREOF, CIRCUIT BOARD AND ELECTRONIC INSTRUMENT

AMENDMENT

Director of the U.S. Patent and Trademark Office
Washington, D.C. 20231

Sir:

In reply to the Office Action mailed April 25, 2002, please amend the above-identified application as follows:

IN THE CLAIMS:

Please replace claims 1, 2 and 4 as follows:

1. (Amended) A semiconductor device comprising:

a semiconductor chip on which a plurality of electrodes are formed;

a first flexible substrate on which a wiring pattern is formed and on which the semiconductor chip is mounted;

a plurality of external terminals electrically connected to the electrodes with the wiring pattern interposed; and

a second flexible substrate adhered to the first flexible substrate avoiding the semiconductor chip,

wherein the second flexible substrate is formed of the same material as the first flexible substrate.

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2. (Amended) The semiconductor device as defined in claim 1,

wherein the first and second flexible substrates are of substantially the same thickness.

4. (Amended) A semiconductor device comprising:

a semiconductor chip on which a plurality of electrodes are formed;

a first flexible substrate on which a wiring pattern is formed and on which the semiconductor chip is mounted;

a plurality of external terminals electrically connected to the electrodes with the wiring pattern interposed;

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a second flexible substrate adhered to the first flexible substrate avoiding the semiconductor chip; and

a conductive layer which is formed between the first and second flexible substrates, of the same material and of substantially the same thickness as the wiring pattern, and is electrically insulated from the wiring pattern.

Please add new claims 27-31 as follows:

27. A circuit board on which is mounted the semiconductor device as defined in claim 4.

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28. An electronic instrument having the semiconductor device as defined in claim 4.

29. A semiconductor device comprising:

a semiconductor chip on which a plurality of electrodes are formed;

a first flexible substrate on which a wiring pattern is formed and on which the semiconductor chip is mounted;

a plurality of external terminals electrically connected to the electrodes with the wiring pattern.interposed; and

a second flexible substrate adhered to the first flexible substrate avoiding the semiconductor chip,

Cont'd B3

wherein the second flexible substrate is formed of a material having a coefficient of thermal expansion substantially equal to a coefficient of thermal expansion of a material of the first flexible substrate.

30. A circuit board on which is mounted the semiconductor device as defined in claim 29

31. An electronic instrument having the semiconductor device as defined in claim 29.

REMARKS

Claims 1-31 are pending herein. By this Amendment, claim 1 is amended to include subject matter of claim 2 and/or 4 therein. Claim 2 is correspondingly amended for consistency with the amendment to claim 1. Claim 4 is amended to be in independent form so as to place this claim in condition for allowance. New claims 27-31 are added.

No new matter is added by this Amendment. Support for new claim 29 may be found in the original specification at, for example, page 16, lines 22-24.

The attached Appendix includes marked-up copies of each rewritten claim (37 C.F.R. §1.121(c)(1)(ii)).

Applicant appreciates the courtesies shown to Applicant's representative by Examiner Thai in the July 24, 2002 interview. Applicant's separate record of the substance of the interview is incorporated into the following remarks.

I. Rejection Under 35 U.S.C. §102(e)

Claims 1, 3 and 8-10 were rejected under 35 U.S.C. §102(e) as allegedly being anticipated by U.S. Patent No. 6,140,707 (hereinafter Plepys). This rejection is respectfully traversed.

In the Office Action, it was alleged that Plepys described a semiconductor device that included a first flexible substrate 50 and a second flexible substrate 52. Applicant respectfully disagrees. In particular, Applicant respectfully submits that Plepys describes layer 52 of the semiconductor device as a "stiffener," the antithesis of flexible, and therefore fails to teach or suggest the semiconductor device of claim 1.

More in particular, at column 6, lines 53-64, Plepys describes that:

> After flexible circuit 50 is prepared as described above, it may be laminated to stiffener 52. Stiffener 52 may be made from a thin, planar material that has adequate stiffness to support the tape assembly with a specified degree of planarity, which is required in order to obtain a flip-chip connection between the chip and the die attachment pads. The stiffener may be conductive or non-conductive, depending on the needs of a specific application. In presently preferred embodiments of the invention, stiffener 52 is made of nickel plated copper having a thickness of 15 to 35 microns. Other materials and dimensions may be selected for use in particular applications by a person skilled in the art.

(Emphasis added).

Thus, Plepys describes layer 52 as a stiffener layer that has adequate stiffness. Such does not teach or suggest, and in fact teaches against, a second flexible substrate as in the semiconductor device of present claim 1.

Further, as explained on page 1 of the present specification, the term "stiffener" in the art conventionally refers to stiff materials such as stainless steel and the like, and the present invention seeks to omit such conventional stiffeners from the semiconductor device. Thus, in referring to layer 52 as a stiffener layer, Plepys teaches to one of ordinary skill in the art the use of a conventional, stiff metal-type layer such as stainless steel or nickel plated copper (as specifically identified in Plepys).

Still further, the fact that stiffener 52 is not a second flexible substrate is confirmed at column 7, lines 57+ in Plepys. There, Plepys describes that an orifice or window 54 may be formed in stiffener layer 52 by etching. As confirmed at column 8, lines 5-7 of Plepys, the use of etching to form the orifice or window 54 in stiffener 52 indicates that stiffener 52 is a conventional metal-type stiffener such as copper.

Thus, Applicant respectfully submits that Plepys does not teach or suggest that stiffener layer 52 is a second flexible substrate as required in the semiconductor device of claims 1 and 29 of the present invention. In fact, as discussed above, Plepys would have directed one of ordinary skill in the art away from the use of a second flexible substrate in place of stiffener 52 described therein.

In addition to the foregoing, Plepys also fails to teach or suggest either (1) a first flexible substrate and a second flexible substrate comprised of the same material as recited in claim 1, or (2) a first flexible substrate and a second flexible substrate comprised of a material having a substantially equal coefficient of thermal expansion as recited in claim 29.

For at least the foregoing reasons, Applicants submit that Plepys does not teach or suggest the present invention. Reconsideration and withdrawal of this rejection are thus respectfully requested.

II. Rejections Under 35 U.S.C. §103(a)

A. Relying Upon Plepys

Claim 11 was rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Plepys. This rejection is respectfully traversed.

Claim 11 is dependent from claim 1. For all the same reasons discussed immediately above with respect to claim 1, Applicant respectfully submits that Plepys also fails to teach or suggest the subject matter of present claim 11.

Accordingly, reconsideration and withdrawal of this rejection are also respectfully requested.

B. Relying Upon Degani

Claims 1, 2 and 10 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent No. 5,646,828 (hereinafter Degani). This rejection is respectfully traversed.

Applicants respectfully submit that Degani does not teach or suggest a semiconductor device having the features recited in claim 1 and in which the second flexible substrate is formed of the same material as the first flexible substrate.

Degani describes a novel packaging of semiconductor elements, such as MCM tiles, with a variety of printed circuit or wired boards (PWB), the packages occupying a small size, at least in the vertical direction, relative to prior art OMPAC devices. The PWB, which may be a single level or a multilevel, is provided with an aperture for accommodation of at least one chip therein. Depending on the type of interconnection between the substrate and the PWB, the aperture may be larger than the substrate of the MCM tile for wire bonding interconnection or smaller than the substrate for solder reflow or conductive adhesive interconnection. In the wire bonding case, the MCM tile is positioned within the aperture resting on the surface of the PWB or of a structural member or of a heat sink which encloses one end of the aperture. The other end of the aperture may be open or enclosed by a structural member, a heat sink, another PWB or a mother board. For solder reflow or conductive adhesive interconnection, the substrate which is larger than the aperture is positioned so that its ends overlap areas of the PWB adjacent the aperture and the chips and/or substrate are positioned within the aperture. The interconnections are enclosed in a compliable encapsulating material, such as silica gel. See the Abstract.

In the Office Action, it was alleged that the embodiment of Figures 9 and 10 of Degani was a semiconductor package in which was included a first flexible substrate 84 and a second flexible substrate 85 of the same material. However, Degani simply describes at column 7, lines 59-62 that "In this variant, however, instead of an MCM tile, a single or a plurality of individual chips, e.g., 81 and 82, are solder reflow interconnected to a hi-level PWB, 83, having a lower level, 84, and an upper level, 85." Such indicates neither that the layers 84 and 85 are flexible nor that they must be of the same material as required by claim 1 of the present application.

Degani indicates at column 8, lines 9-13 that the PWB may be flexible if single-sided, but is rigid if double-sided. Describing that a single-sided PWB may be flexible does not teach or suggest that the multilevel PWB, or layers thereof, illustrated in Figures 9 and 10 is flexible. And again, such also does not teach or suggest that layers 84 and 85 must be comprised of the same material.

Degani also fails to teach or suggest the invention of claim 29, in which the second flexible substrate is formed of a material having a coefficient of thermal expansion substantially equal to a coefficient of thermal expansion of a material of the first flexible substrate. By having the coefficients of thermal expansion be substantially equal, when the first and second flexible substrates are heated and cooled down, little stress arises between the first and second flexible substrates. As such, warping of the first flexible substrate can be restrained to maintain the planarity of the first flexible substrate. Thus, the semiconductor device of claim 29 has great reliability for mounting.

Degani does not teach or suggest a device in which the first and second substrates are made to have substantially the same coefficient of thermal expansion, or the foregoing advantages associated with such construction. Therefore, Applicants respectfully submit that Degani also fails to teach or suggest the invention of claim 29.

For at least the foregoing reasons, Applicant respectfully submits that Degani fails to teach or suggest the claimed semiconductor device. Reconsideration and withdrawal of this rejection are respectfully requested.

III. Allowable Subject Matter

Applicant gratefully acknowledges the indication in the Office Action that claims 4-7 contain allowable subject matter. As claim 4 has been amended to be in independent form, Applicants submit that these claims should now be in condition for allowance.

IV. Conclusion

In view of the foregoing amendments and remarks, Applicant submits that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 1-31 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in better condition for allowance, the Examiner is invited to contact Applicant's undersigned representative at the telephone number listed below.

Respectfully submitted,

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JAO:CWB/rxg

Attachment:
Appendix

Date: July 25, 2002

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DEPOSIT ACCOUNT USE AUTHORIZATION
Please grant any extension necessary for entry;
Charge any fee due to our Deposit Account No. 15-0461